GEOG Climate Science Lab

TEXAS A&M UNIVERSITY




Experiences of the North American Soil Moisture Database

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Developing a Coordinated National Soil Moisture Network, Nov. 2013

Building the North American Soil Moisture Database

- Identify all sources of *in situ* soil moisture data in the United States, Mexico and Canada
- Collect station metadata from all sites
- Perform QA/QC on soil moisture data
- Bias-adjust and homogenize the soil moisture data
- Generate gridded soil moisture products

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TAMU North American Soil Moisture Database

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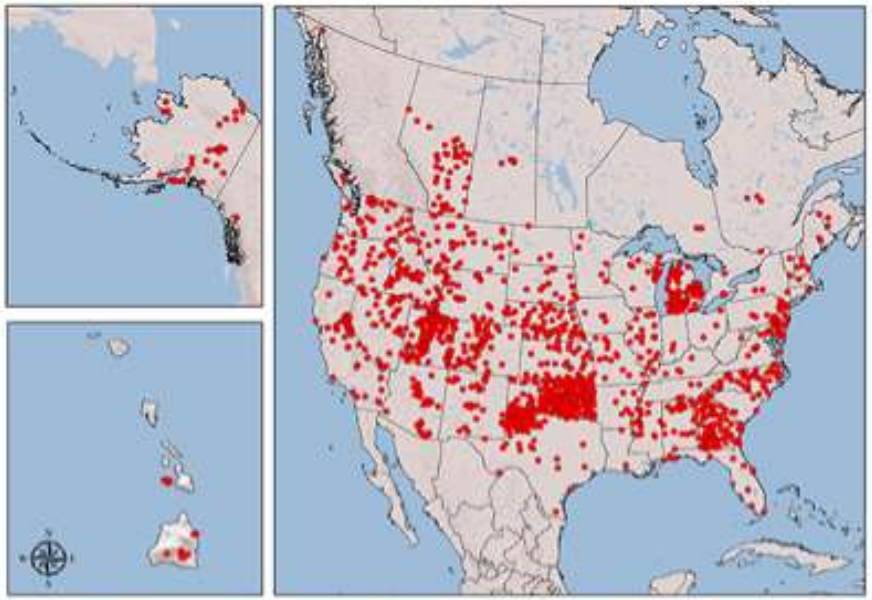


The North American Soil Moisture Database (NASMD) is a harmonized and quality-controlled soil moisture dataset that helps investigate land-atmosphere interactions, validates the accuracy of soil moisture simulations in global land- surface models and from satellite platforms, and describes how soil moisture influences climate on seasonal to inter-annual timescales.

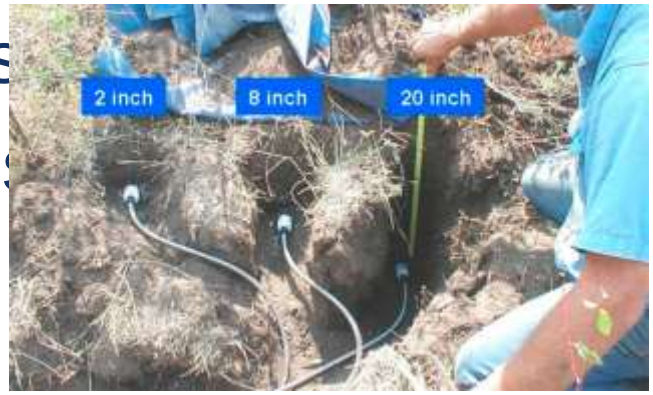
The NASMD was developed and constructed at the Department of Geography's Climate Science Lab at Texas A&M University.

soilmoisturemaps.tamu.edu

BETA VERSION!

North American Soil Moisture Database

- We have identified >1800 stations
- We have data from >1500 stations
- More than 1200 stations are at: soilmoisturemaps.tamu.edu



- Although many of these stations are only available since the 1990s, some are available prior to the 1950s

- Includes a variety of sensors, soil water variables, depths, sampling frequencies

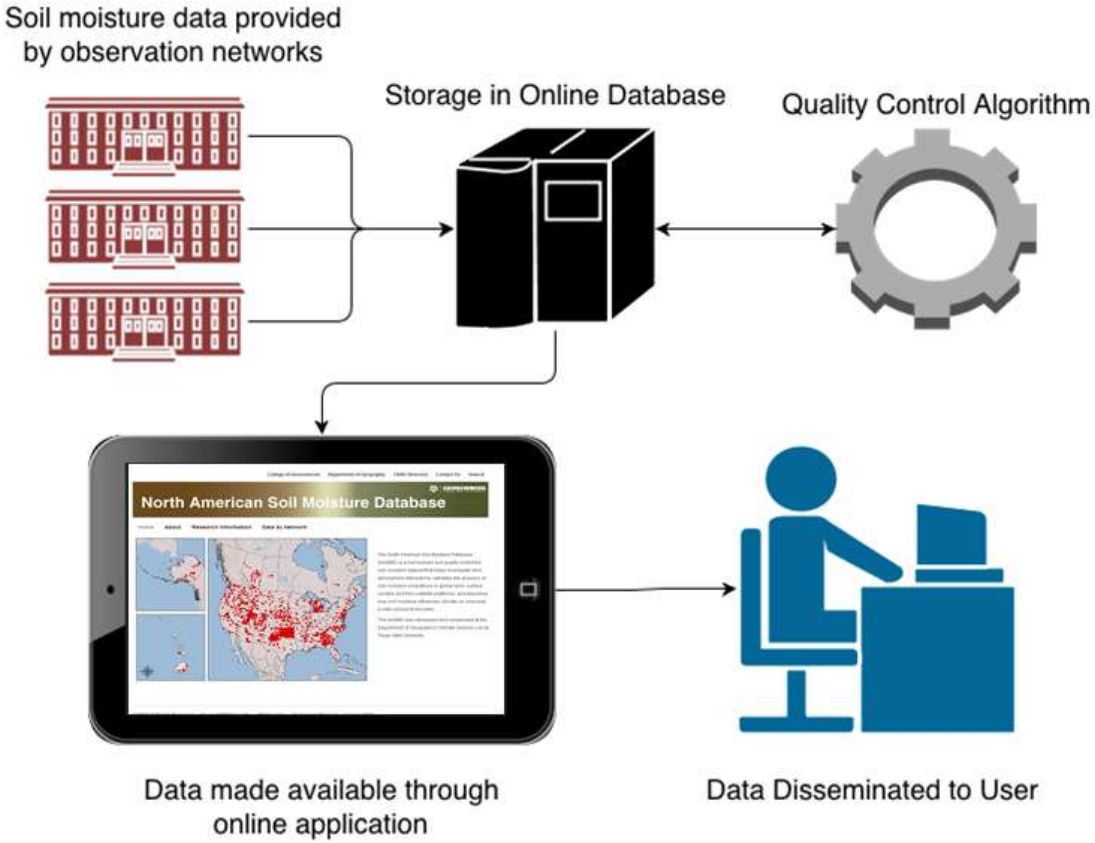
North American Soil Moisture Database

- I. NASMD includes national, regional, state and local networks. It also includes in situ soil moisture data collected during field campaigns, and research projects.

- II. Comprehensive meta-data has been developed for all of the stations including sensor, soil characteristics, surface vegetation, and details on instrument calibration.

- III. All data has gone through our customized QA/QC algorithm. Measurements failing the QC checks are flagged for further analysis.

North American Soil Moisture Database

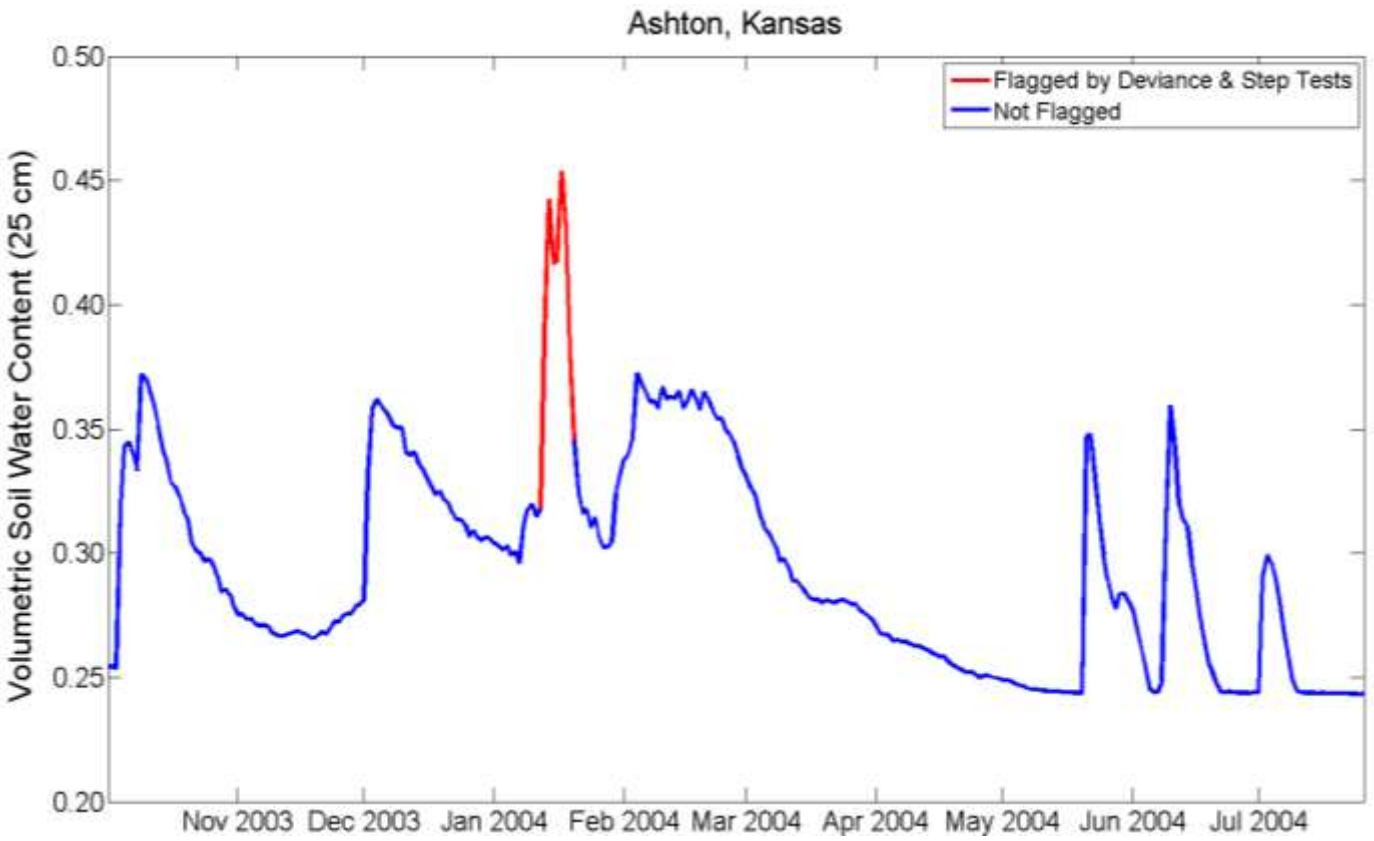


Data Quality Control

- Because each station/network performs varying levels of data quality control, it is necessary to carefully screen all observations using a consistent set of tests
- Multi-stage process patterned after USHCN (Menne & collaborators), and Oklahoma mesonet (among others)

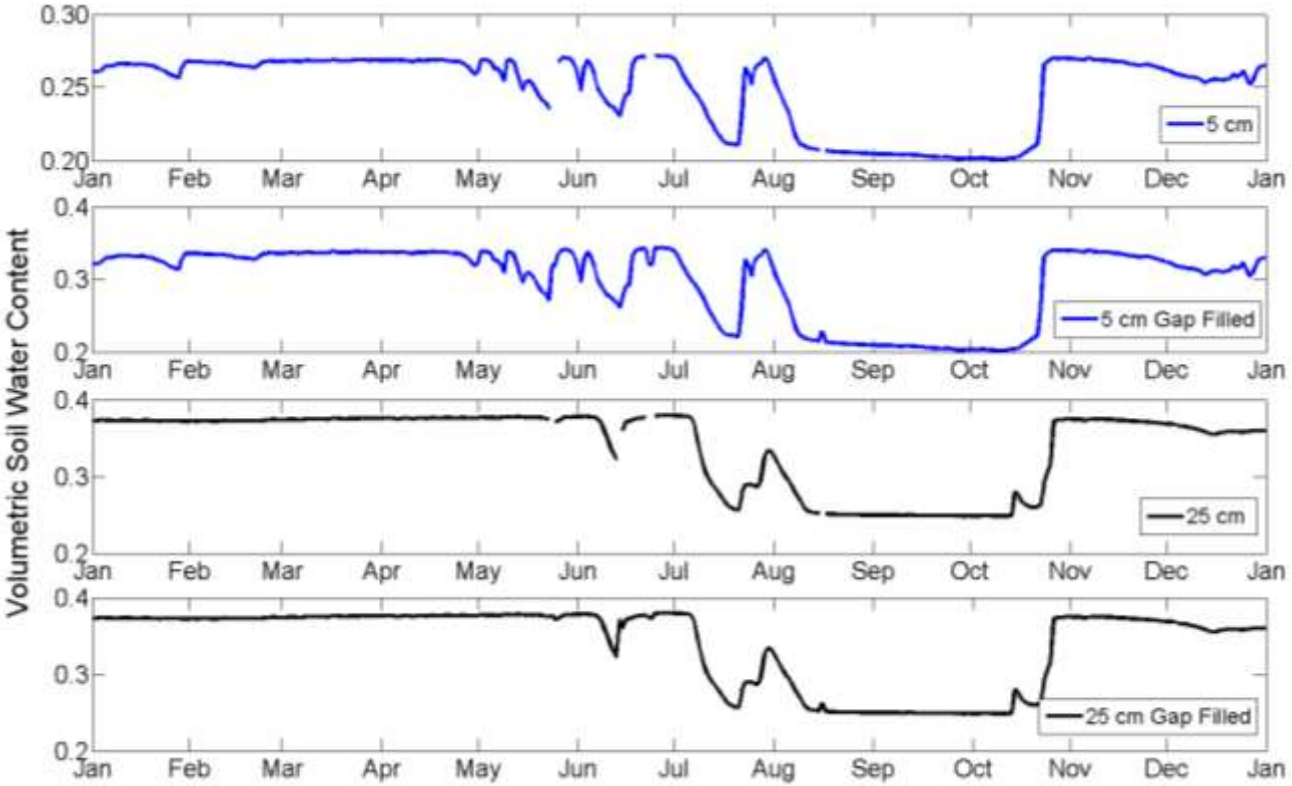
- Four validation tests: range, streak, deviance, and step
- > 7 million values processed: streak, deviance and step tests flagged 0.52%, 4.40% and 3.22% of the data, respectively

North American Soil Moisture Database



Soil moisture data from the 25 cm depth at Ashton, Kansas. Data shown in blue were not flagged by the deviance and step tests while data in red were flagged.

North American Soil Moisture Database



Soil moisture plots from 5 and 25 cm depths in Acme, Oklahoma in 2000. The bottom two plots (black) show soil moisture data before they are filled by the DAR procedure, and the top two plots (blue) show the data after infilling.

North American Soil Moisture Database Interactive Map

This interactive map allows you to view & download station data from the North American Soil Moisture Database.

Choose one or more networks from the dropdown list to see station data. Use the depth & year sliders to filter. Click the extract buttons to download station data.

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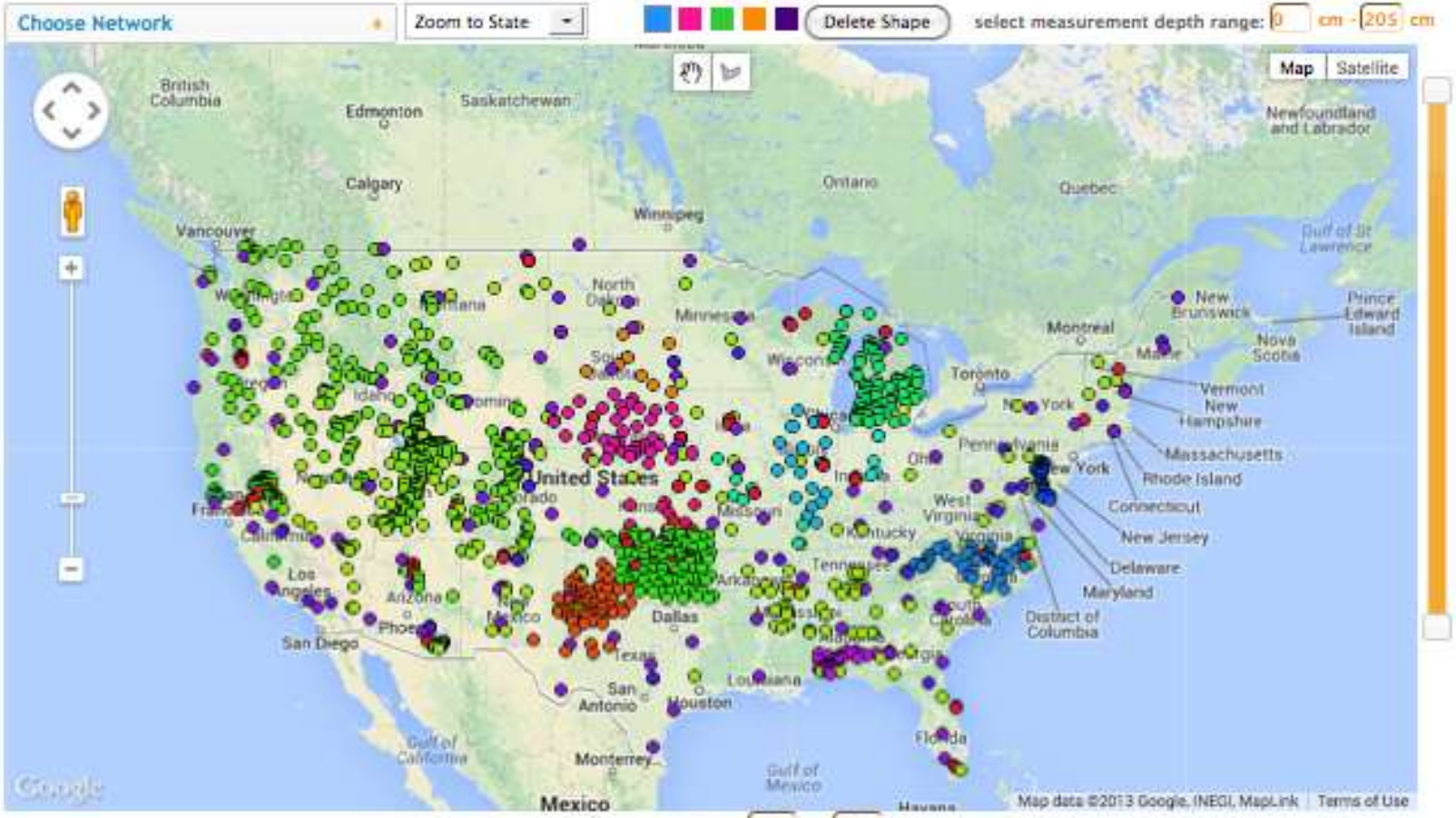

1237 Stations have been selected

No.	All	Station	Network	Location	State
1	☐	Norman	Oklahoma Mesonet	Norman	Oklahoma
2	☐	Acme	Oklahoma Mesonet	Rush Springs	Oklahoma

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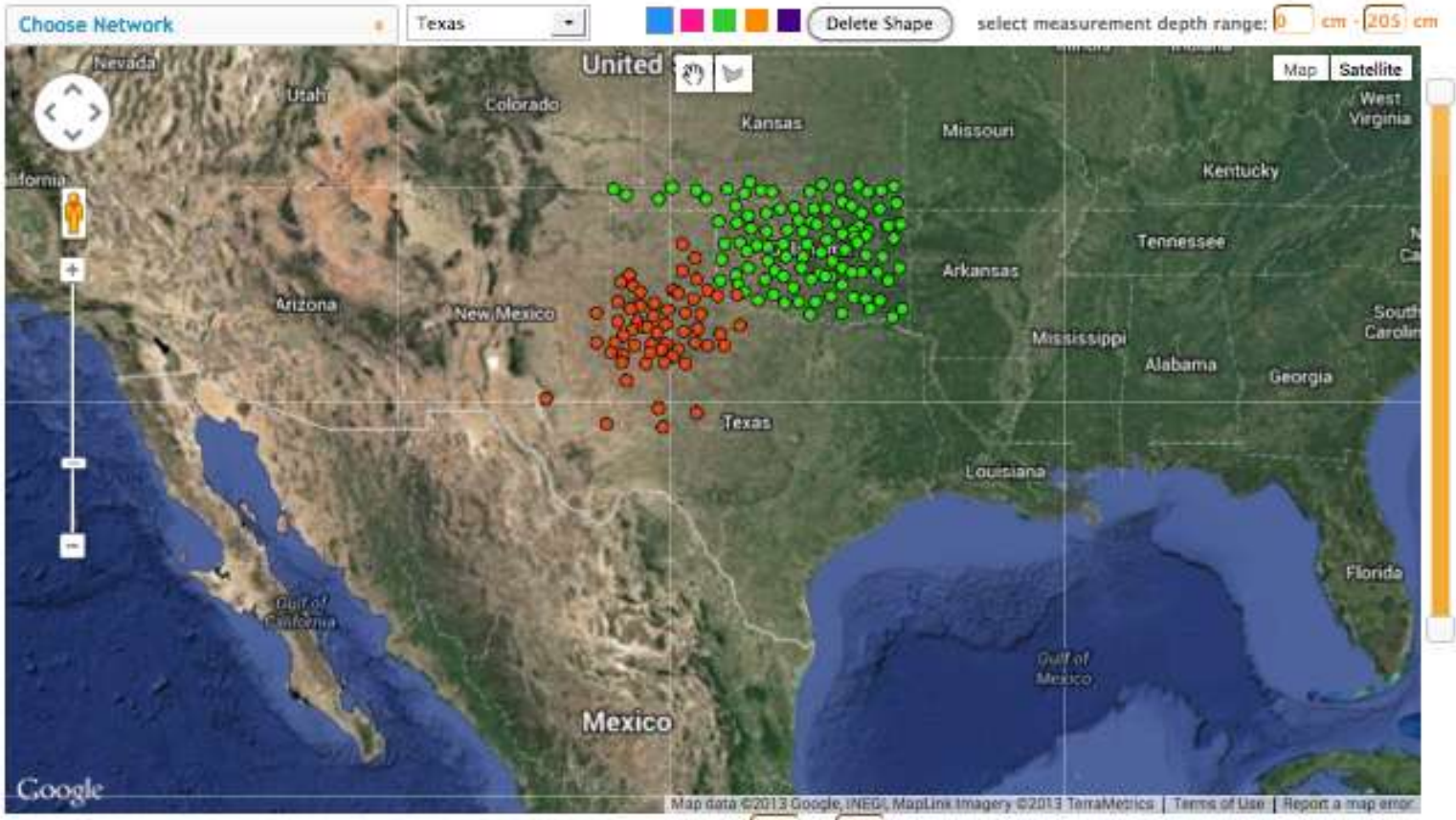

Slide to select data year range: 1991 - 2013

163 Stations have been selected

No.	All	Station	Network	Location	State
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2	☐	Acme	Oklahoma Mesonet	Rush Springs	Oklahoma

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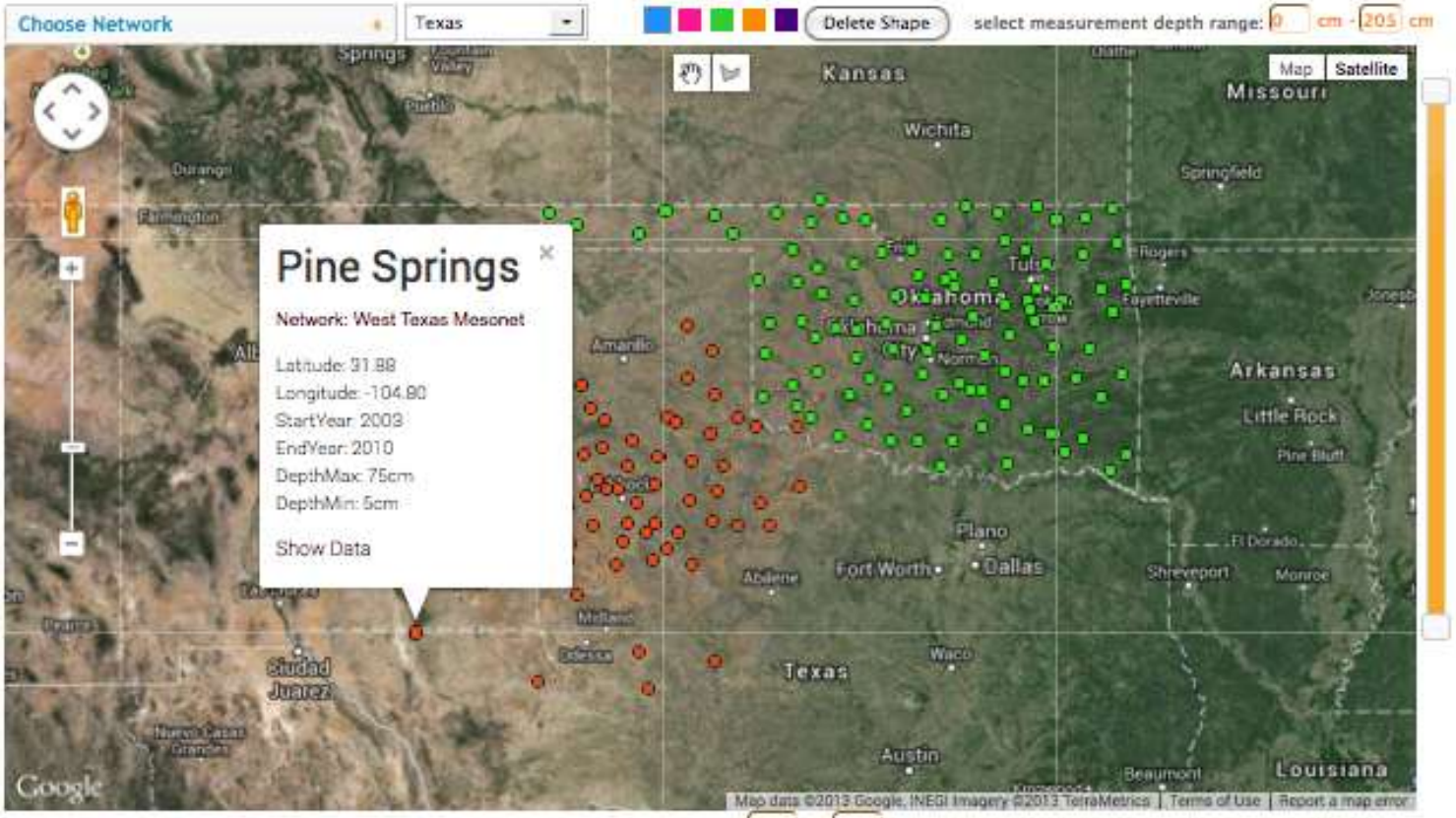

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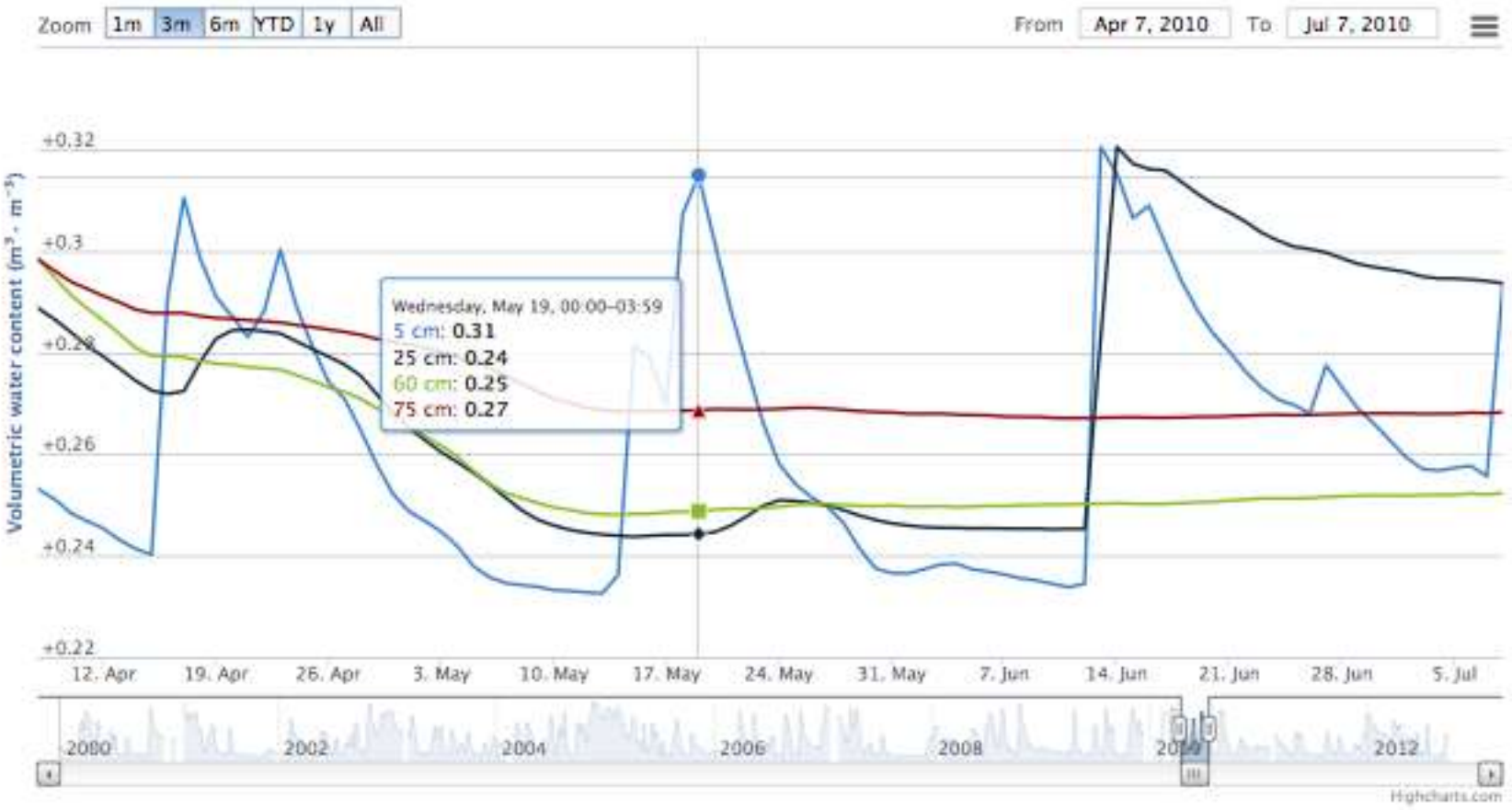
1	☐	Norman	Oklahoma Mesonet	Norman	Oklahoma
2	☐	Acme	Oklahoma Mesonet	Rush Springs	Oklahoma
3	☐	Ada	Oklahoma Mesonet	Ada	Oklahoma

Station Data



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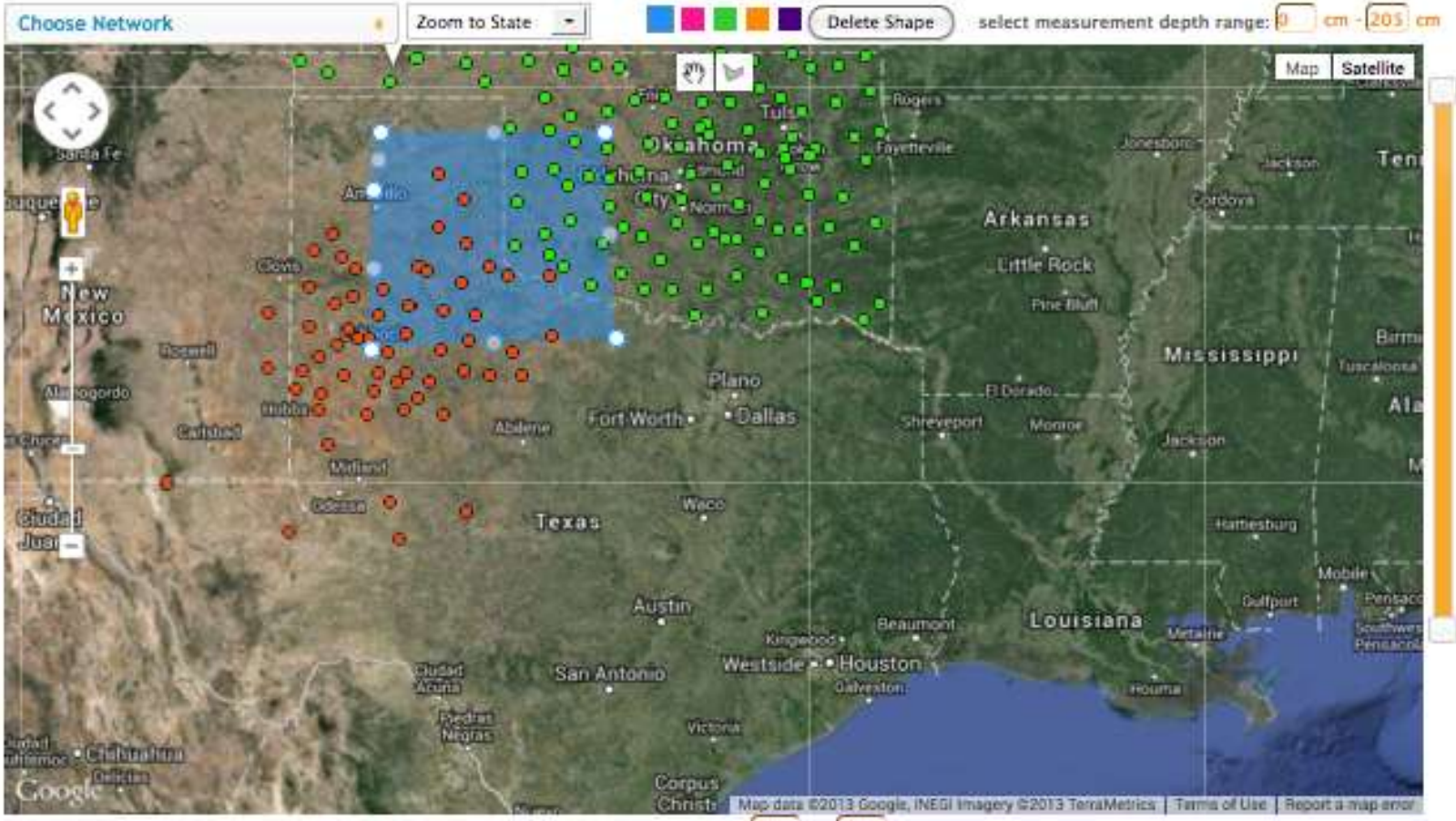


Slide to select data year range: 1991 - 2013

32 Stations have been selected

No.	All	Station	Network	Location	State
1	☐	Altus	Oklahoma Mesonet	Altus	Oklahoma
2	☐	Arnett	Oklahoma Mesonet	Arnett	Oklahoma

32 Stations have been selected

No.	All	Station	Network	Location	State
1	☑	Altus	Oklahoma Mesonet	Altus	Oklahoma
2	☑	Arnett	Oklahoma Mesonet	Arnett	Oklahoma
3	☑	Bessie	Oklahoma Mesonet	Bessie	Oklahoma
4	☑	Butler	Oklahoma Mesonet	Butler	Oklahoma
5	☑	Camargo	Oklahoma Mesonet	Camargo	Oklahoma
6	☑	Cheyenne	Oklahoma Mesonet	Cheyenne	Oklahoma
7	☑	Erick	Oklahoma Mesonet	Erick	Oklahoma
8	☑	Grandfield	Oklahoma Mesonet	Grandfield	Oklahoma
9	☑	Hobart	Oklahoma Mesonet	Hobart	Oklahoma
10	☑	Hollis	Oklahoma Mesonet	Gould	Oklahoma
11	☑	Mangum	Oklahoma Mesonet	Mangum	Oklahoma
12	☑	Medicine Park	Oklahoma Mesonet	Medicine Park	Oklahoma
13	☑	Putnam	Oklahoma Mesonet	Putnam	Oklahoma
14	☑	Tipton	Oklahoma Mesonet	Tipton	Oklahoma
15	☑	Weatherford	Oklahoma Mesonet	Weatherford	Oklahoma
16	☑	Abernathy	West Texas Mesonet	Abernathy	Texas
17	☑	Childress	West Texas Mesonet	Childress	Texas
18	☑	Clarendon	West Texas Mesonet	Clarendon	Texas
19	☑	Floydada	West Texas Mesonet	Floydada	Texas
20	☑	Goodlett	West Texas Mesonet	Goodlett	Texas

Extract Checked Stations

Extract All Selected Stations

No.	All	Station	Network	Location	State
1	☑	AURO	ECONET	Aurora	North Carolina
2	☑	BEAR	ECONET	Hendersonville	North Carolina
3	☐	BOON	ECONET	Boone	North Carolina
4	☐	BUCK	ECONET	Buckland	North Carolina
5	☐	BURN	ECONET	Burnsville	North Carolina
6	☐	CAST		yne	North Carolina
7	☐	CLA2			North Carolina
8	☐	CLAY			North Carolina
9	☐	CLIN			North Carolina
10	☐	DURH			North Carolina
11	☐	FLET			North Carolina
12	☐	GOLD		o	North Carolina
13	☐	HAML	ECONET	Hamlet	North Carolina
14	☐	HIGH	ECONET	High Point	North Carolina
15	☐	JACK	ECONET	Jackson Springs	North Carolina
16	☐	KINS	ECONET	Kinston	North Carolina
17	☐	LAKE	ECONET	Raleigh	North Carolina
18	☐	LAUR	ECONET	Laurel Springs	North Carolina
19	☐	LEWS	ECONET	Lewiston	North Carolina
20	☐	LILE	ECONET	Lilesville	North Carolina

Extract request queued. You will receive an email shortly.

OK

Extract Checked Stations

Extract All Selected Stations

Challenges

I. *Data sharing.* Some networks in the U.S. and Canada do not freely provide data. There are no funds in the NSF project to pay for acquiring these datasets.

II. *Quality control.* We are ingesting data from all networks. We have noticed that the quality of the observations varies from network to network.

III. *Research versus operational.* The goal of the NASMD is to provide an integrated database of historical soil moisture data. We are interested in transforming the NASMD into a near-real-time operational system, but at this point we do not have funding to do this.

Future Work

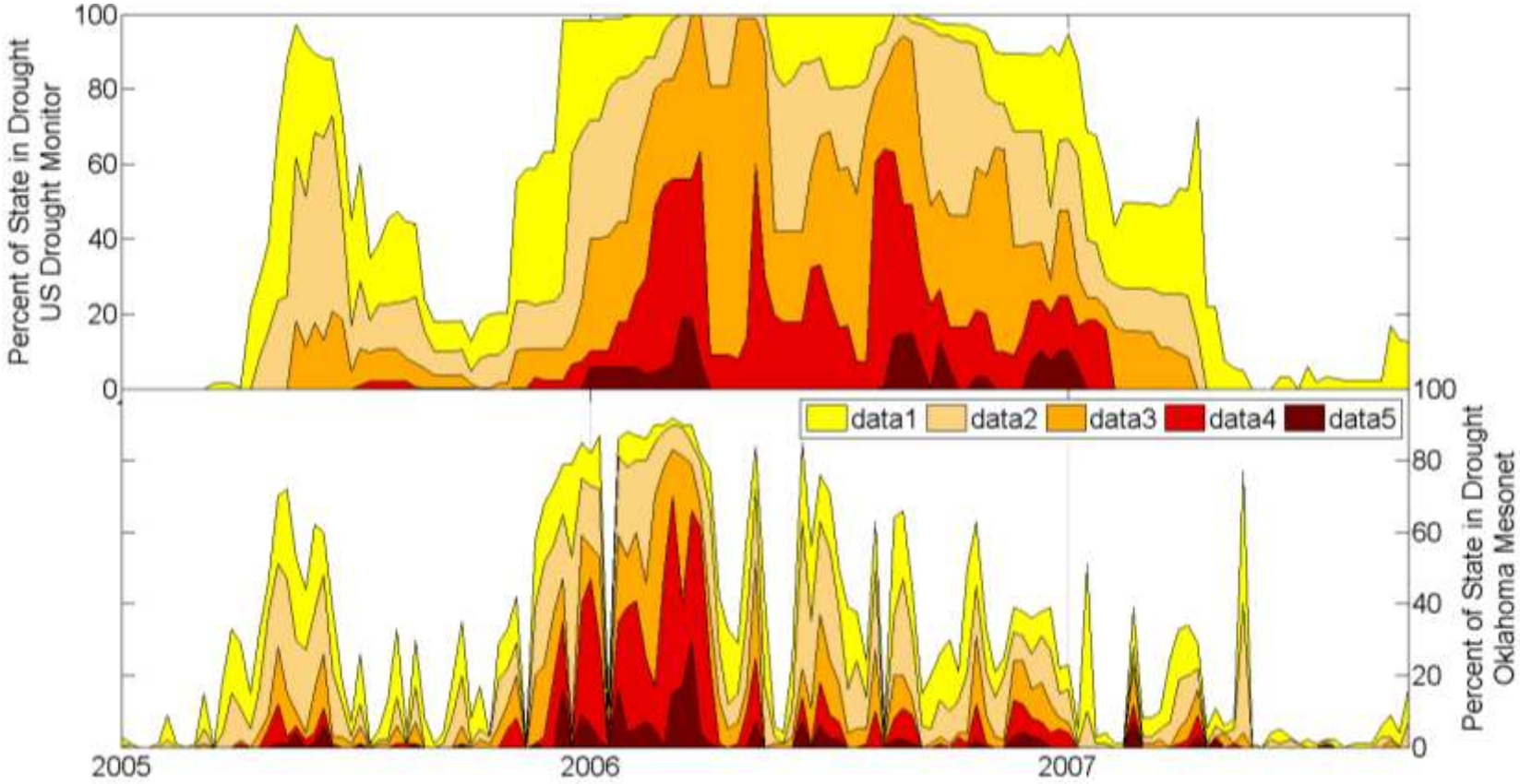
I. Identify additional stations, especially in Canada and Mexico.

II. Develop gridded observational soil moisture products using our customized interpolation algorithm. Products include: degree of saturation, soil moisture percentiles, and standardized soil moisture index.

III. Employ these data for satellite calibration/validation (NASA SMAP)

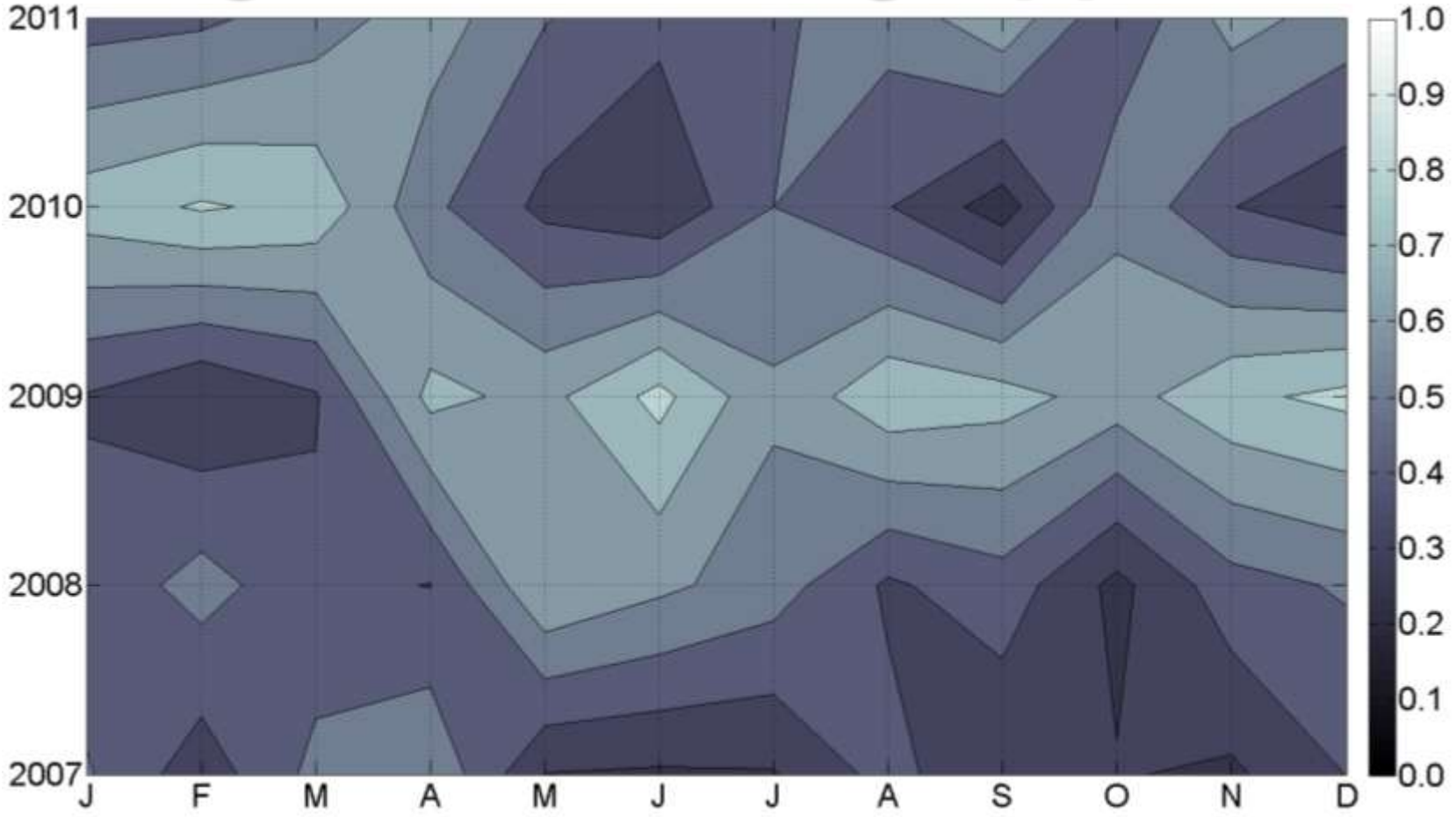
IV. Other research applications…

Drought Monitoring Application



Available soil water (5 cm to 75 cm). Percentage of Oklahoma in drought between 2005 – 2007. Areas are color-coded by USDM drought severity. The top plot is from the U.S. Drought Monitor and the bottom plot are from soil moisture percentiles at Oklahoma Mesonet stations.

Drought Monitoring Application



Composites of monthly average soil moisture percentile, average over all sites in the Delaware Environmental Observing System (DEOS)

Acknowledgements

- This project is funded by the NSF Climate & Large-scale Dynamics (CAREER ATM-1056796)

- Major contributors:
  - Trent Ford

- Research Assistants:
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North American Soil Moisture Database

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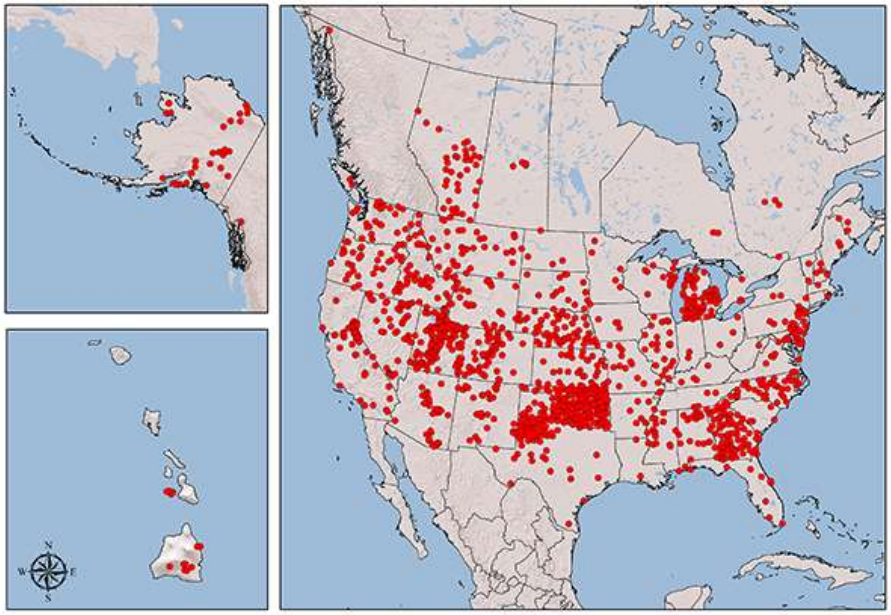

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The NASMD was developed and constructed at the Department of Geography's Climate Science Lab at Texas A&M University.

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soilmoisture.tamu.edu

Research Goal

The goal of my NSF CAREER project is to understand how soil moisture influences climate on seasonal to interannual timescales in the U.S. Great Plains.